1 Introduction

The set of experiments forming the g8a run took place in the summer of 2001 (6/04/01 – 8/13/01) in Hall B of Jefferson Lab. These experiments [1, 2, 3, 4] made use of a beam of linearly-polarized photons produced through coherent bremsstrahlung, representing the first time such a probe has been employed at Jefferson Lab. Among the several new and upgraded Hall-B beam-line devices commissioned prior to the production running of g8a were the photon tagger, the coherent bremsstrahlung facility (goniometer and instrumented collimator), a photon profiler, and the PrimEx dipole and pair spectrometer telescopes. We essentially commissioned a new beamline for photon running in Hall B. For the first phase of g8, i.e. g8a, we collected approximately 1.8 billion triggers in the photon energy range 1.75–2.2 GeV.

The scientific purpose of the g8 run is to improve the understanding of the underlying symmetry of the quark degrees of freedom in the nucleon, the nature of parity exchange between the incident photon and the target nucleon, and the mechanism of associated strangeness production. With the high-quality beam of the tagged and collimated linearly-polarized photons and the nearly complete angular coverage of the Hall-B spectrometer, we seek to extract polarization observables for the photoproduction of vector mesons and kaons at photon energies ranging between 1.1 and 2.2 GeV.

In this document, we shall first summarize the underlying motivations for our set of experiments.[1] We next will report on our results of the commissioning of the beamline devices and will recount the progress of our preliminary analysis of the g8a run. We then will argue that a continuation of g8 at lower energies is both necessary and timely. Because the second phase of g8 will gather data at lower energies, $1.1 < E_\gamma < 1.75$ GeV, ϕ production will be precluded.

2 Motivation for Using Linearly-Polarized Photons

The excitation spectrum of the nucleon is one of the most important constraints on any theory of strong interaction. The nonperturbative nature of QCD at low energies has represented a major challenge to hadronic physics, and has made necessary the use of phenomenological quark models. In these models, the internal structure of the nucleon is represented by three constituent valence quarks interacting with each other through a potential. An outstanding problem in our current day understanding of baryon spectroscopy is the question of the so-called "missing resonances". SU(6)⊗O(3) symmetric quark models predict far more resonances than have thus far been observed. One solution is to restrict the number of internal degrees of freedom by assuming that two quarks are bound in a di-quark pair [5], thereby lowering the level density of baryon resonances. An alternate solution has been put forward by Koniuk and Isgur [6] and others [7, 8, 9, 10, 11]. In these calculations it has been found that the missing resonances tend to couple weakly to the πN channel but stronger to the ρN, $\pi\Delta$, ωN, and $K\Lambda$ channels. Since most of our information on the baryon resonance spectrum comes from partial-wave analyses of $\pi N \to \pi N$, $\pi N \to \pi\pi N$, and $\gamma N \to \pi N$ measurements, these 'missing states' will clearly have escaped detection.

2.1 Photoproduction of Vector Mesons

Of special interest are those predicted resonances which are inconsistent with the di-quark model, like $P_{11}(1710)$, $P_{13}(1870)$, and $F_{15}(1955)$ which have – according to the quark model of Isgur and Karl [12] – a large branching ratio into ρN and ωN as well as reasonable photon-coupling. For this reason, a Hall-B electroproduction experiment [13] searches for resonances decaying via the

[1] For more information we refer the reader to the corresponding chapters in the proposals.